THESIS

For the Degree of M.D., EDINBURGH UNIVERSITY,

on

LUMBAR PUNCTURE

SIXTY CASES.

by

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LUMBAR PUNCTURE.

SIXTY CASES.

The operation of Lumbar Puncture was introduced by Quincke of Kiel, in 1890, as a valuable therapeutic agent in grave disorders of the central nervous system, to relieve symptoms caused by intracranial pressure.

This use of the operation was very much over estimated, although in certain conditions, such as tubercular meningitis, headaches and vertigo caused by increased pressure, it may be of use as a palliative treatment. It was not until 1900 that attention was called to the examination of the Cerebro-Spinal Fluid by Widal, Sicard and Ravaut as being of diagnostic value in affections of the Central nervous system. Widal and Ravaut had applied certain methods of examination to other fluids in the body, now they applied them to the Cerebro-Spinal fluid, and showed that its systematic examination yielded information of high value in diagnosis of certain pathological conditions of the central nervous system. The earlier investigations were carried out on fluid drawn from/

from the various forms of acute meningitis and consisted of an examination as to the characters physical, chemical and cytological of the fluid. This investigation is now included as a routine method in diagnosis of certain neurological conditions.

The method adopted in this series for the operation was as follows :-

The spinal cord with its pial covering ends at the lower border of the first lumbar vertebra or the upper border of the second vertebra. The arachnoid and dura extend to the level of the second sacral vertebra forming a sac devoid of spinal cord and occupied by the roots of the cauda equina and the cerebrospinal fluid which protects them. It is from this region that the fluid can be drawn off without risk of injury to the cord. Occasionally, one of the large roots is touched and may cause either a twitch of the muscles of the lower extremities or a sharp twinge of pain, but this is at once relieved by slightly withdrawing the needle and no injury appears to be caused. In the present series in only one instance was this effect noticed. The fourth interspace was first attempted as being the largest, and in a large majority of/

of cases proved successful. A needle at least three inches in length was used for puncturing an adult. Where the condition of the patient allowed, the sitting posture was adopted, but where this was not advisable the position of lying on the side, with the thighs well flexed on the abdomen and the back well bent had to be resorted to, as in this way the laminae were separated as far as possible. The skin was sterilized and frozen with ethylchloride, the sterilized needle being then introduced half an inch to one side of the middle line at a level just below the fourth lumbar spine, located by the line giving the level of the iliac crests. It was then driven with a slightly upward direction and inwards to hit off the middle line at the centre of the bony canal. If the direction were correct, the point of the needle could be felt to pierce the tough ligamenta subflava, enter the canal, and then pass forward without much resistance. Even when the needle was well within this canal, fluid would not always flow. Sometimes this may have been due to membrane or nerve root floating against the aperture of the needle, or to a small clot of blood or plug of tissue which could be removed by using a stillette/

stillette or slightly withdrawing and then again advancing the needle. At other times it appeared to be due to the needle having entered and passed between the membranous and bony walls of the sac. This condition was specially noted in one case of pneumococcal meningitis in the series, where repeated punctures had to be made, all of which entered the bony canal, before the fluid, which was under high pressure, could be obtained. It seemed as though the membranous sac must have been anatomically small compared to the bore of the bony canal.

Aspiration was never attempted. The normal cerebro-spinal fluid is clear as crystal and under normal pressure should flow from the needle drop by drop. But in some conditions the fluid may be turbid, cloudy and even purulent, as in some cases of meningitis. In severe cases of jaundice, it has been observed to be yellow and clear. The pressure may be considerably raised, so that instead of flowing drop by drop, it spurts out in a strong jet.

In meningitis, the fluid is occasionally under no increased pressure, nor is it in the least degree turbid. In these cases, it is only by microscopic examination/

examination of the centrifugal deposit, that a diagnosis can be arrived at, and this is further aided by culture made from the fluid to show the nature of the organismal infection. Carducci reports a case in which there was no increase of pressure, the fluid was clear and further the centrifuged deposit showed no increase of leucocytes. The post-mortem examination showed a diffuse purulent meningitis. The absence of leucocytes in the fluid was supposed to be due to the exudation being of too tenacious a character to mix with the cerebro-spinal fluid. Culture showed that the causal organism was the influenzal bacillus of Pfeiffer.

Frequently the first few drops are stained with blood from the needle wound passing through the superjacent structures. This red staining however, may be due to more deep seated injury and is of surgical interest as denoting the presence of intracranial haemorrhage. Haemorrhage may occur from intracranial contusion without fracture of the skull. The first few drops that come from the needle are caught in a separate test tube to avoid as far as possible/

possible contamination from adventitious blood; then a further 5c.c., when possible, are collected in a graduated centrifuge tube. This is then centrifuged for ten to fifteen minutes in an electric centrifuge. The supernatant fluid is carefully decanted and allowed to drain, and any deposit visible or otherwise is collected in a fine capillary pipette and blown out on to a glass slide to give a drop 2 to 3mm. in diameter. This is then either fixed with heat and stained with methylene blue or stained without previous fixing with Jenner's stain. The supernatant fluid is then tested for albumin by Heller's test. Care has to be taken to follow out this technique of Widal's with exactness otherwise very variable results may follow. Armand-Delille and Camus failed to find lymphocytosis in tabes and general paralysis and therefore reported examination of the fluid as of no importance. This is contrary to the finding of all other authorities and Widal, Ravaut and Sicard contend that these results were due to faulty technique, probably to insufficient draining of the supernatant fluid. No ill effects were observed to follow from the operation either mild or/

or serious, with one possible exception. This was in a case of general paralysis in which 48 hours after the puncture, the patient had a typical congestive attack with a high temperature, which fell to normal at night but again rose the following morning to fall again at night, and remain subnormal. J. Minet and F. Lavoin collected 34 cases reported with fatal result. The majority of these (23) were of intracranial tumour. In 9 of the cases, post-mortem examination showed intense congestion of the cerebral vessels, followed by rupture and fatal haemorrhage, in the other 25 cases the cause of death was obscure. They adopt Martin's explanation of bulbar shock produced by intense vaso-motor phenomena causing severe histological lesions of the bulbar centres. They further recommend Sicard's prophylactic treatment, namely that the patient be kept in bed for 24 hours before, and 48 hours after the operation, that the operation be performed with patient lying on the side and that not more than 4 to 8 c.c. be aspirated; also that puncturing cases of intracranial tumour be avoided, when the symptoms can be relieved by other palliative treatment. These recommendations/

recommendations were not observed except as to the amount of fluid withdrawn at a time; the punctures being all performed at night after the patient had been in bed two or three hours, and he got up at his usual hour the following morning.

As to the origin of the cerebro-spinal fluid, it is stated by Mott and E.Buck that it is a true secretion and not an exudation; being most probably secreted by choroid plexus. The epithelium covering the choroid plexus is formed of polygonal cells with large nuclei and their cytoplasm contains numbers of round and oval clear areas which are probably the fore-runners of the secretion. Clinical observation shows that the fluid is continuously secreted. The fluid thus continually secreted fills all interstices in the subarachnoid space and a quantity is continually escaping. It may escape along the perineural lymphatics and these may be the channels of infection in the production of meningitis. Cushing, however, maintains that the fluid chiefly finds exit by the longitudinal sinus. In disease of the nervous system/

system, micro-organisms are rarely found in the cerebro-spinal fluid, but are to be found in the various forms of meningitis. Schiff has found that the diplococcus of Weichselbaum is not infrequently found in the human organism and concludes that the nose is the seat of infection. Flatau has shewn that there are connections between the naso-pharynx and the subarachnoid space by means of the perineural and perivascular lymphatics. Mott also considers that infection takes place by this channel and not by means of wandering leucocytes containing the infecting micro-organism.

Flexner finds in the case of epidemic poliomyelitis, if the virus is implanted on the intact mucous membrane of the nose that this is sufficient to produce the disease. Further, that if a monkey be sacrificed, 48 hours after an intranasal inoculation, the brain and spinal cord being removed and afterwards the olfactory lobes, portions of the medulla and spinal cord being separately inoculated into other monkeys, infection is produced by the olfactory lobe only/

only, since, in this short time, the virus has not yet reached other and more distant parts of the nervous system. In the case of the meningococcus it is not sufficient to inoculate the mucous membrane of the nose; the meningococci must be injected into the meninges themselves. But when so injected they escape in part along the nerves of smell and the nose.

The normal cerebro-spinal fluid contains few or no organised elements, but in meningitis, whether tubercular or non-tubercular and in chronic affection of the central nervous system, a leucocytosis is one of the earliest evidences of organic disease. A polymorpho-nuclear leucocytosis denotes an acute congestive or inflammatory affection and a mononuclear leucocytosis a chronically advancing, irritating affection. Mott states that the contrifugalised normal fluid should contain no cells. Purves Stewart says, that there should not be more than 4 cells in a normal fluid when the drop, stained and prepared as above, is examined with a magnification of 400 diameters. He gives the following averages in a series of cases which he has examined.

4-10 cells

In the combined degeneration of pernicious anaemia

Acute myelitis in Syphilitic cases

Tubercular tumour of the cortex cerebri

Persistent headache of obscure origin.

10-25 cells

In gumma of the cord

Landry's paralysis

Endothelioma of the cord

Long standing syphilis with hemiplegia

25-400

In general paralysis

Tabes dorsalis

Gumma of crus cerebri

Gumma of the spinal cord

Syphilitic hemiplegia

Tubercular meningitis

Glioma of corona radiata.

J.A.Greenfield states that where the fluid could be thoroughly centrifuged, he found 10 to 12 lymphocytes/

lymphocytes in normal fluids: further, that in no case did he find complete absence of these cells, except where the fluid had been kept for sometime in a tube other than that used for centrifuging. The propensity of leucocytes to adhere to glass is well known and this probably accounted for the absence in these cases.

As to the cause of this lymphocytosis, which is most marked in the metasyphilitic affections of the central nervous system, L.Merzbacher states that nine out of every ten cases of Syphilis (with no demonstrable Syphilis of nervous system) showed a positive increase of the lymphocytes, but without the very marked increase of the general paralysis and tabes. In eye cases of various natures, where there was no reason to suspect a local affection of the meninges, there was always a history of Syphilis where the puncture gave an increase of the leucocytes. Again, he says, that there is no sound reason to explain the lymphocytosis which uniformly accompanies the Argyll-Robertson phenomena by a local affection of the meninges. So again in brain tumour, hemiplegia and

and paraplegia, cerebral haemorrhage whether there is a lymphocytosis or not, is dependent on the presence or absence of a Syphilitic history. So also in tabes dorsalis and general paralysis, when there is no evidence of meningeal affection, the lymphocytosis is present. Therefore, he concludes, that it is safer to refer the lymphocytosis to Syphilitic infection rather than to meningeal changes: though later, the latter no doubt play an important part in producing a lymphocytosis: the common factor in all cases of lymphocytosis being the Sylphilitic infection which disturbs that mechanism, and which, under physiological conditions, regulates the admission of cells to the cerebro spinal fluid.

As stated above, the lymphocytosis is most marked in the metasyphilitic conditions. Armand-Delille and Camus alone appear to throw doubt on the importance of this in diagnosis, and this failure is considered by Widal, Sicard and Ravaut to be due to faulty technique. Purves Stewart states that an average of not more than four cells to the magnification of 400 diameters should/

should be found in a normal fluid. Widal, Sicard and Ravaut say that for a distinct positive reaction at least 6-10 should be found. J. G. Greenfield however, states that he has found 10-12 in normal fluids. In this series of cases, an average of 4 or less is looked on as pointing to a normal condition, from this number up to 10 as pointing to a pathological condition, and above this number as being definite evidence. The increase of lymphocytes reaches its highest limit in General Paralysis, W. Boyd having reported a count averaging 3450. Both in this condition and in that of tabes, the result is of great importance, especially in the diagnosis of early cases, the lymphocytosis being definite in the earliest stages. In cases where general paralysis is suspected, a lumbar puncture should always be performed, as a positive increase of cells is strong, almost positive confirmation that the suspicion is correct. The absence of lymphocytosis is extremely rare, though cases are reported by Achard and Grenet, Joffroy, Mercier, Ballet and Delherm. Purves Stewart/

Stewart has punctured cases at regular intervals, which were under-going rigorous anti-syphilitic treatment at the time, and has found that the treatment has had no effect in reducing the lymphocyte counts. The polymorpho-nuclear leucocytes in acute conditions, are followed during recovery by mononuclears, but these disappear as the condition clears up.

Ernest Jones states that proteid is a constituent of normal cerebro-spinal fluid. It is greatly increased in inflammatory conditions, particularly in those of the meninges and in the metasyphilitic conditions. This was pointed out by Babcock in 1895, by Nawratzki in 1897 and confirmed by Schaefer in 1902.

The increase is usually, but by no means invariably, parallel to the degree of the lymphocytosis present. Leibscher points out that the lymphocytosis due to metasyphilitic conditions is more frequently accompanied by increase in the proteid element than the lymphocytosis due to tertiary syphilitic conditions. Zilanakis states that the increase of proteid may occur in general paralysis/

paralysis at a time when no lymphocytosis is present.

As to the nature of the proteid normally present, there is some divergence of opinion, but the preponderance of evidence is, that normally globulin is present and not albumin. The definition of globulin taken, is that afforded by the various salt solubility tests. Others, however, state that there is a very small quantity of albumin normally present. In syphilitic conditions the opinion is fairly unanimous that serum albumin is found in considerable quantities. Nissl and Schoenborn state that they find mainly albumin present and that globulin is rare. Other workers including Widal, Sicard, Ravaut, Pegna, Nonne and Apelt find that the globulin is present in relatively large amounts as compared,with the albumin present.

The following cases of Lumbar Puncture were performed whilst acting as House Physician in the Royal Infirmary, Edinburgh, and I am indebted to Dr. Byrom Bramwell for his permission to make use of the cases.

The/

The cases may be roughly divided into two groups. Firstly, those in which a diagnosis had been arrived at and in which the puncture was performed to confirm the general rule in such conditions, or to find out what was the actual nature of the fluid. Secondly, where the diagnosis was in doubt, and the puncture was made in the hope that the condition of the fluid would give some help in arriving at a correct diagnosis.

In the series, there are fifty-one cases and the Lumbar Puncture was performed on sixty occasions. In some instances the puncture was repeated as a control on the first examination; in others to find if there were any change, or on account of fresh clinical symptoms having arisen in the condition.

The cases are arranged as follows :-

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5 cases of cerebral syphilis.

13 " " tabes dorsalis.

4 " " general paralysis.

9 " including one case of progressive muscular atrophy.

one case of cerebral haemorrhage.

two cases of Hodgkin's Disease.

one case of old hemiplegia with Jacksonian attacks.

two cases of spastic paraplegia.

two cases of disseminated sclerosis.

7 cases of intracranial tumour.

4 cases of meningitis.

9 cases in which the diagnosis was in doubt and the puncture was made in the hope that it would give assistance.

The cases are given in these groups with comments as considered necessary at the end of each group with a short summary, and at the conclusion a more general summary of the whole series is given as far as possible. Taking into account such/

such diversity as there is between the different groups of cases, it was not easy to write only a general and final summary; I have, therefore, thought it best to give a short one with each group as well as finally. Not being able to read any foreign language, I cannot pretend to have studied the whole of the bibliography appended. The literature and original articles to which I had access are given at the close with their references.

FIVE CASES OF CEREBRAL SYPHILIS.

	PRESSURE.	FLUID.	ALBUMIN.	LYMPHOCYTES.
CASE I.	Slightly increased.	Clear	Much increased.	500 per field
II.	Normal	Clear	distinctly increased.	120 per field
III.	Normal	Clear	slightly increased.	40 per field
IV.	Normal	Clear	normal	500 per field
V.	Normal	Clear	distinctly increased.	300 per field

In/

In CASE I. there was a paralysis of the third right cranial nerve of long standing, dizziness and headaches worse at nights which cleared up under treatment.

CASE II. had night headaches for some months and during the past month a right-sided hemiplegia had come on. Finally there was paresis on the left side, with thickness of speech, which all cleared up under anti-syphilitic treatment.

CASE III. Here there had been attacks transitory in nature of paralysis of the right arm and during the last two seizures they had been accompanied by aphasia.

CASE IV. Paralysis of the right arm with paresis of the right leg, which also cleared up under treatment.

CASE V. Patient was suffering from headache, dizziness, with reeling faintness, and there was paralysis of the third cranial nerve. Loss of intelligence and a mental attitude rather pointing to general paralysis of the insane were also/

also present. There was a fairly recent history of hard chancre. The condition cleared up entirely under administration of Mercury and Iodide treatment. Case V. was the only one in which a definite history of syphilis could be obtained.

CASES I., III & V admitted frequent exposure to infection, but gave no other indication. The Cytological contents of the fluid showed a very considerable increase in all the cases, being specially marked in four. The albuminous content in three of the cases was distinctly increased, slightly in one, (Case III.,) and normal in amount in the remaining one, (Case IV.) The relation between the increase of the cellular and albuminous contents was fairly constant except in Case IV. where the cellular content was very markedly increased without any increase in the albuminous.

TWELVE/

TWELVE CASES OF TABES DORSALIS.

	PRESSURE	FLUID	ALBUMIN	LYMPHOCYTES
Case I.(1).	Normal	Clear	Increased	100
(2).	Normal	"	"	"
Case II.	Increased	"	"	35
Case III.	Increased	"	"	55
Case IV.	Normal	"	"	200
Case V.	Increased	"	"	25
Case VI.	Normal	"	"	100
Case VII.	Increased	"	"	28
Case VIII	Normal	"	Normal	10
Case IX.	Normal	"	Normal	200
Case X.	Normal	"	Increased	35
Case XI.	Normal	"	Normal	250
Case XII.	Normal	"	Normal	6
Case XIII	Normal	"	Increased	28

Case I/

CASE I. was punctured a second time, as there was a record of the patient having been punctured one and a half years previously, on which occasion the result had shown two hundred lymphocytes when examined in the same manner.

CASE VII. showed in addition to the lymphocytes, that there was a considerable number of polymorphonuclear leucocytes in a ratio of two polymorpho-nuclear to one mononuclear. The results here were fairly constant, and showed a distinct increase of the cellular content as was expected, with the exception of two cases (VIII and XII).

CASE VIII. had not very marked symptoms and some doubt was expressed as to the diagnosis which was borne out by the result of the puncture.

CASE XII. was a very marked one of tabes, and the result of the puncture could throw no doubt on the diagnosis. No cause could be assigned for the polymorpho-nuclear cells found in Case VII, the case being a typical tabes. There were no red corpuscles in the film, so that the possibility of considerable haemorrhage was put out of count.

The albuminous content was increased in

all/

all except four of the cases bearing a relation to the increase of the cellular content, with two marked exceptions, Cases IX, and XI, which had such marked increase of their cellular content as two hundred and two hundred and fifty cells.

FOUR CASES OF GENERAL PARALYSIS OF THE INSANE.

	PRESSURE	FLUID	ALBUMIN	LYMPHOCYTES
CASE I. (a)	increased	Clear	Much increased	120
(b)	Further increase	"	"	120
CASE II.	Much increased	"	Very markedly increased.	350
CASE III.	Normal	"	Much increased.	150
CASE IV.	increased	"	Much increased	350

CASE I. is the only case I have seen in which one/

one might possibly blame the puncture for having caused bad after-effects. The first puncture was done late one evening, and the patient seemed quite as usual on the two following days. The morning of the third day, patient had a temperature of 101:6 F. and acted as though suffering from a congestive attack, all his mental symptoms being much exaggerated. The temperature fell to normal that night, and a second Lumbar Puncture was performed, which showed that the pressure was still further increased and the albumen as before. The lymphocytes were as before, but in addition, a large number of polymorpho-nuclear leucocytes in the proportion of three to one mononuclear was present, also a few red blood corpuscles. No organisms could be discovered. The following morning the temperature again rose to 101.2 but fell to 98 F. at night and remained subnormal. The rise in temperature and the presence of the polymorpho-nuclear leucocytes was however probably not owing to any infection due to the first puncture, but to the incidence of the congestive attack.

Three/

Three of the above cases were quite typical in every way of General Paralysis of the Insane, and with a definite history of having suffered from syphilis.

CASE II. gave no history of syphilis, his mental condition was characteristic, and in addition he had well marked double optic neuritis. The variability in pressure with which the fluid was expressed, may be accounted for by the restlessness of those patients in whom it was increased. Case II. was very restless and in the end was punctured while sitting up in bed and pulling hard on an assistant's hands. The albuminous and cellular contents were both increased to a marked degree as was expected.

NINE/

NINE CASES IN WHICH THE FLUID WAS EXPECTED TO BE NORMAL.

		PRESSURE	FLUID	ALBUMIN	LYMPHOCYTES.
CASE 1.	Progressive Muscular Atrophy.	Normal	Clear	Normal	3.
CASE 2.	Cerebral Haemorrhage.	"	"	"	0.
CASE 3.	Lymphadenoma.	"	"	"	3.
CASE 4.	Lymphadenoma.	"	"	"	2.
CASE 5.	Old Hemiplegia with Jacksonian attacks.	Slightly increased	"	Slightly increased	5.
CASE 6.	Paraplegia.	Normal	"	Normal	3.
CASE 7.	Paraplegia.	"	"	"	3.
CASE 8.	Disseminated Sclerosis.	"	"	"	8.
CASE 9.	Disseminated Sclerosis.	"	"	"	10.

In these nine cases, as expected, there

was/

was no marked change from the normal, there being no affection of the meninges nor any metasyphilitic condition. The hemiplegia with the Jacksonian attacks gave an average of five lymphocytes to the field, with slightly increased pressure and slight increase of the albuminous content. The two cases of disseminated sclerosis gave lymphocyte counts of eight and ten; they were both well advanced cases. This finding agrees with that of J.G. Greenfield, who in a series of six cases found an average of 6-15 cells in this condition. Case II. of cerebral haemorrhage showed no abnormality and there was no coloration of the fluid as frequently happens in such cases. The condition was verified by post-mortem examination.

INTRA CRANIAL TUMOUR - SEVEN CASES.

	PRESSURE	FLUID	ALBUMIN	LYMPHOCYTES
CASE 1.	Normal	Clear	Slightly increased	220.
CASE 2.	Normal	Clear	Normal	18.
CASE 3.	Slightly increased	Clear	Normal	3.
CASE 4.	Increased	Clear	Increased	25.
CASE 5.	Increased	Clear	Normal	8.
CASE 6.	Normal	Clear	Considerably increased	1.
CASE 7.	Normal	Clear	Slightly increased.	5.

All the above seven cases had very definite symptoms of intracranial tumour, all terminated fatally whilst under observation, and a post-mortem examination verified the diagnosis in each case.

In CASESI, II, III, tumour was situated

in/

in one of the frontal lobes.

CASE IV. occupied the region of the mid-brain.

CASE V. was a tumour of the pituitary body.

In CASE.VI. the tumour was in the cerebellar pontine angle.

In CASE VII. there was a small tumour in the neighbourhood of the Foramen of Majendie and the left temporo sphenoidal lobe was a mere shell wall of a cyst containing clear fluid: the whole lobe collapsed as the fluid escaped from a rupture in the brain substance, when the brain was removed from the skull.

The results of the Lumbar Puncture in these cases was intensely varied, only three cases showing distinct increase of the cellular contents, and only one showing much increase of the albuminous contents. This last showed the smallest number of lymphocytes to the field.

CASE I. was punctured about three months after the first onset of symptoms which were of/

a Jacksonian nature: this gave the largest increase of the cellular content.. The post-mortem examination showed pathological condition of the meninges, but only of recent origin. An operation had been performed and meningitis supervened, due to the patient's restlessness and continuous attempts to remove the dressing from his wound.

CASE II. The condition here was far advanced before the Lumbar Puncture was performed and there was not a very large increase found in the lymphocytes. At the post-mortem examination, no gross changes were found in the meninges, except around the site of the wound, caused by a decompression operation.

CASE III. In this case the puncture was made during the early onset of symptoms. There was slight increase of pressure but otherwise the fluid was normal. At the autopsy, the meninges under the Calvarium/

Calvarium were affected with metastases, the growth being of an adenosarcomatous nature. The puncture was made some five months before the autopsy; at that time it was unlikely that the growth had affected the meninges.

CASE IV. was a case of very long standing and the puncture was carried out shortly before its fatal termination, when convulsions were of frequent occurrence. Here there was increase of pressure shown with increase of the albuminous content and of the lymphocytes. The increase of pressure may have been due to the fact that the patient was restless and struggled a little before the puncture was made.

CASE V. Here there was a history of persistent headache for some eighteen months, and while there was slight increase of pressure, the cells only showed eight to the field.

CASE/

CASE VI. was one of cerebellar pontine tumour and the only change observed was a considerable increase of the albumin.

MENINGITIS - FOUR CASES.

CASE I. The diagnosis here was not arrived at with any certainty before the Lumbar Puncture was made, and the same may be said of the other three cases. In this case a history was obtained of severe frontal headache and vomiting of four days duration. A few hours before admission, the patient had become suddenly unconscious. When seen he was quite unconscious, breathing noisily, with flushed face, the eyes turned to the right and the conjunctival reflex was lost. There was no head retraction and Kernig's sign was not present. All the deep reflexes were increased, the right plantar/

plantar reflex gave an extensor response, and the left a flexor. Pulse 110, Temperature 103·2, Respirations 44. There was a polymorpho-nuclear leucocytosis of 42,000 per c m. and a very positive glycogenic reaction.

Great difficulty was experienced in reaching the fluid. The needle without doubt penetrated the ligmanenta subflava and entered the bony canal, but did not find the subarachnoidal space. Three punctures were made in the space between the fourth and fifth lumbar vertebrae without success. Three further punctures were made between the third and fourth vertebrae and with the last the fluid was reached which spurted out at very high pressure. At such high pressure, it was unusual to have so much difficulty in reaching the fluid. In the rest of the series of cases there was frequently some difficulty/

difficulty in penetrating the bony canal, but very rarely trouble in reaching the fluid when once within the vertebral canal. The fluid was very thick and turbid, of almost milky appearance. There was a very large increase in the albuminous content. On centrifuging, there was a thick creamy deposit thrown down and films could not be made in the usual manner; smears were, therefore, made between two cover slips.

The microscopical examination of these showed a film of polymorphonuclear leucocytes, some in early stages of degeneration. There were in addition, numerous extra-cellular diplococci present with capsules which stained with Muir's method. These were further proved by their cultural characteristics to be Fraenkels Pneumococci.

CASE II. When first seen this case was suspected of/

of being possibly meningitis, with a history of frontal headache and persistent vomiting of a week's duration. During the last two days the patient had become very listless and drowsy. When first seen patient was very drowsy but could be roused. There was no head retraction, Kernig's sign was absent, the abdomen was retracted. There was some dulness on percussion at the base of the right lung, Pulse 76, Temperature 97·6, Respirations 20. Lumbar Punctures showed that the fluid was quite clear and the pressure normal. The albuminous content was slightly diminished, but the film showed an average of thirty Lymphocytes to the field. Next day, there were the usual physical signs of typical croupous pneumonia at the base of the right lung. The following day the consolidation showed signs of resolution and diplococci were found in numbers in the sputum. During these two days, the/

the temperature remained at normal, there was no headache and the patient's mental condition was much brighter. The next day, that is the fourth day after coming under observation, the temperature rose to 102·4 with severe frontal headache. The neck was held rigid but without retraction. Kernig's sign was not present and the affected portion of lung showed further signs of resolution.

Lumbar Puncture was again performed. The fluid on this occasion was under very high pressure and very turbid, with increase of albumin. On centrifuging, a heavy creamy deposit was thrown down and films, as in the previous case, had to be made between cover slips. On examination these showed a few lymphocytes and red blood corpuscles, and numerous polymorpho-nuclear leucocytes.

Several/

So Several films made in this way were searched for micro-organisms. Two diplococci were found after long searching, one being intracellular and the other extracellular. Culture of the fluid proved negative.

A post-mortem examination could not be obtained and the organism causing the meningitis could not, therefore, be definitely proved. It was presumed, however, that it was the same as that causing the pneumonic consolidation.

CASE III. This patient gave more typical signs of meningitis than the two previous cases. A history was given of severe frontal headache coming on four days before admission. Patient rapidly got worse, wandered a good deal in his speech, and could be roused from his semi-concious condition only with difficulty. There had been violent vomiting whenever food had been administered. When seen, patient/

patient could not be roused to consciousness, the face was flushed, the head retracted, the conjunctival reflex was present and the face drawn to the right side. The deep reflexes were all exaggerated and there was an extensor response to the left plantar reflex.

The Lumbar Puncture showed the fluid to be clear and the pressure did not appear to be increased. The albuminous content was also not increased. After centrifuging, it was found that a slightly blood stained deposit had been thrown down, but not so thickly as to prevent the film being made in the usual way with a capillary pipette. These films showed an average of fifty polymorpho-nuclear leucocytes and six lymphocytes to the field. On further magnification, diplococci and large thick rod shaped bacilli were found to be present. Cultures made at the post-

post-mortem examination showed streptococcus pyogenes aureus present. The large bacilli were not recovered.

CASE IV. Patient had suffered from pains in the head, body and limbs for about two weeks and was, on admission, in a drowsy condition and at times delirious. He would answer questions, and complained of pains in his forehead and back. There were physical signs of consolidation at the right apex. Half the tongue had been excised three years previously for tuberculous disease. The tendon reflexes were active and rather more so on the left than on the right. The plantar reflex gave a flexor response. Pulse 22, Temperature 98·4, Respirations 20. The Lumbar Puncture showed a clear fluid with a normal pressure. The albuminous content was distinctly increased. A heavy deposit was thrown down on centrifuging, and/

and films had to be made between cover-slips. On examination these showed very numerous polymorpho-nuclear leucocytes with a few lymphocytes. Although several films were carefully examined, some being stained with Ziehl Nielsen's stain for Tubercle bacilli, no organisms were detected. Two days later a second puncture was made and the fluid run directly into a flask of bouillon for incubation. This, however, proved negative. Three days later the patient's temperature rose to 101° F., the pulse running between sixty five and seventy five. Patient became quite unconscious, developed Kernig's sign with ankle clonus and there was an extensor response to the plantar reflex. The condition ended fatally in two days after the rise in temperature.

The Post-mortem examination showed chronic fibroid phthisis in the upper/

upper lobes of both lungs. The cerebro-spinal fluid was clear but increased in quantity, the convolutions of the brain being flattened. The pia arachnoid was thickened and there were numerous small tubercular nodules scattered over its surface.

Nine cases in which the diagnosis was in doubt and Cerebro-Spinal Fluid was examined to ascertain if it would throw light on the condition.

PRESSURE/

		PRESSURE	FLUID	ALBUMIN	LYMPHOCYTES
CASE I.		Normal	Clear	Normal	2.
CASE II.		Normal	Clear	Much increased	60.
CASE III.		Diminished	Clear	Normal	5.
CASE IV.	(1)	Normal	Clear	Normal	10.
	(2)	Normal	Clear	Increased	8.
CASE V.	(1)	Increased	Blood stained	Normal	See history of case
	(2)	Slightly increased	Clear pinkish color.	Normal	
	(3)	Normal	Clear	Normal	
CASE VI.	(1)	Increased	Clear	Much increased	1,000.
	(2)	Normal	Clear	Normal	20.
	(3)	Normal	Clear	Normal	12.
CASE VII.	(1)	Increased	Clear	Increased	400.
	(2)	Increased	Clear	Increased	400.
CASE VIII.		Normal	Clear	Normal	6.
CASE IX.		Normal	Clear	Normal	4.

CASE I./

CASE I. This patient was an old soldier who admitted exposure to infection of syphilis, but firmly denied having suffered from the disease. The patient had been under observation for some twelve years suffering from giddiness, Rhombergism, ataxic gait and shooting pains. These symptoms had gradually increased. The knee jerks had remained active and the pupil reacted to both light and accommodation. The condition had been diagnosed as an atypical tabes dorsalis. He returned to hospital exhibiting a marked voluntary tremor of the arms which did not agree with the diagnosis. The possibility of this being a case of disseminated sclerosis was now entertained. A Lumbar Puncture was done and on examining the fluid no change was found from the normal.

CASE II. was admitted complaining of numbness and weakness beginning in the legs and later/

later affecting the arms. There were marked fibrillary twitchings and great weakness in the affected muscles. This condition rapidly spread over the rest of the muscles and the patient was completely incapacitated when he was removed to his home in Germany. The Lumbar Puncture showed no increase of pressure but the albumin was much increased and the lymphocytes up to sixty per field.

CASE III. This patient complained of shooting pains in the head, difficulty in walking and hallucinations. There was a marked fine tremor of the hands, and speech affection similar to that in General Paralysis of the Insane. In this case the pressure on making the Lumbar Puncture was found to be diminished, the albumin normal in amount and the cellular content not increased.

CASE IV. For a week before admission this patient had been in bed in a somewhat somnolent/

somnolent condition, wandering in his speech with some headache, but capable of answering questions. There had been occasional attacks of vomiting both before and since taking to his bed.

When first seen, patient lay still on the bed groaning, muttering and yawning occasionally, answered when spoken to, but replies about his name, age and address were quite inaccurate. The face was dusky with occasional twitches of the muscles. When asked, said he had no pain, but often put his hand to his haed and seemed to have some difficulty in finding his head. There was no tenderness of the head made out. Pulse 60, Temperature 98·4, Respirations 22. All the tendon reflexes present. No Kernig's sign. Plantar reflex gave a flexor response on both sides. No optic neuritis. On making the first Lumbar Puncture, the pressure was found to/

to be normal, also the amount of albumin, and the lymphocytes ten per field. Four days later, when the patient seemed very much in statu quo, except that his movements were rather more inco-ordinate, a second lumbar puncture was made. On this occasion, the fluid showed some increase of albumin, lymphocytes eight per field and a few poorly staining polymorpho-nuclear leucocytes were observed.

Two days later patient died. Before that, the right arm and leg had become flaccid, and on the left side spastic. Kernig's sign and an extensor response were present on both sides.

At the Post-mortem examination, a round mass, the size of a tangerine orange, was found in the upper lobe of the left lung and a large mass of the same matter was found in the right frontal lobe of the cerebrum.

This/

This growth on examination proved to be a round celled sarcoma.

CASE V. Patient had been apparently in good health until two days before he was seen, when he suddenly became unconscious with some convulsive movements and vomiting. After a short time he became semi-conscious and seemed to be suffering from headache. When seen, patient lay quietly in bed, the face flushed and the forehead wrinkled. All the limbs moved freely. All the deep reflexes were present and active. The right plantar reflex gave a flexor and the left an extensor response. Kernig's sign was not present. The neck was stiff but not retracted. No tenderness of the head was made out. No optic neuritis. There was a trace of albumin in the urine and a high blood pressure, 182 millimetres of mercury. Pulse 80, Temperature 98, Respirations 18. Talked/

Talked and answered questions in an incoherent fashion, also groaned from time to time.

This case was in many ways both in looks and behaviour very similar to CASE III.

A Lumbar Puncture was made on admission, again two days later and a third time after an interval of three weeks. While in Hospital, patient gradually improved up to a certain point. He had occasional sudden and violent attacks of vomiting, as if of cerebral origin. After a time he was able to walk with assistance, gained sufficient intelligence to insist on leaving Hospital and was then unfortunately lost sight of.

In the first Lumbar Puncture, the fluid contained a good deal of blood and owing to this was not transparent. On centrifuging, there was a red deposit. The film under the microscope showed red blood/

blood corpuscles, polymorpho-nuclear and mono-nuclear lymphocytes in about the proportion in which one would expect to find them in normal blood. The second examination of the fluid made two days later, showed it to be of a pinkish colour but quite transparent. Again there was a distinct red deposit, which under the microscope showed the cells to be in number and proportion much the same as above.. The condition of the cells showed some degeneration, nor did they take up the stain quite so well as on the previous occasion.

The third examination some three weeks later, showed the fluid with a slightly yellowish tinge, but no deposit was visible after centrifuging. Under the microscope, an average of three to four lymphocytes was seen, as well as a few degenerate polymorpho-nuclear leucocytes and red blood corpuscles. On all three/

three occasions, the pressure was not increased and the albuminous content was also normal. As mentioned above, the Clinical picture reminded one very much of CASE IV; so too, the last examination of the cerebro-spinal Fluid showed similar characteristics.

CASE VI. This case was of considerable interest. He was punctured on three occasions, at intervals roughly of six months and the examination of the fluid showed marked changes. When first seen, patient showed early symptoms of General Paralysis of the Insane of a rather melancholic type. He had delusions that his mates were not treating him fairly. His speech was somewhat thick and slightly slurring in character. The pupils were unequal, their margin irregular and they contracted only sluggishly to light. The tendon reflexes were active and the plantar reflex on both

sides/

sides gave an extensor response. At times there was incontinence of both urine and faeces. Patient was generally in a very weak and helpless condition. Lumbar Puncture showed increase of pressure and the lymphocytes an increase of one thousand per field, the greatest increase in this series.

Patient was taken home by his wife, as he was not considered to be a suitable case for treatment in Hospital.

Six months later, patient returned to hospital for a certificate of fitness, having been at work for some time. He had markedly improved in his general condition, but was still strange in manner. The speech condition was much as before, very slow and deliberate. He had been sent for a certificate, because his employer was afraid that he would damage himself at his work. He had then left sided facial paralysis.

On/

On this occasion the Lumbar Puncture showed, that the only difference from the normal fluid, was an increase of the Lymphocytes to twenty, a very marked decrease from the condition six months previously.

Patient remained in Hospital some four weeks and was discharged in very much the same condition as when admitted.

After another interval of six months, patient appeared again in very much the same condition as before. On this occasion, Lumbar Puncture showed that the cellular contents had undergone a still further diminution to twelve.

CASE VII. A soldier, age 27, was admitted to Hospital complaining of severe generalised headache extending over four weeks, with giddiness and vomiting of two weeks duration. He admitted having had both gonorrhoea and syphilis. When seen, the/

the patient was dull, apathetic and unsteady in his gait. All his tendon reflexes were somewhat diminished, but there was no definite diminution in his muscular power. There was distinct optic neuritis in both eyes. The Lumbar Puncture showed that both the pressure and the albumin were distinctly increased. The cellular content was in great excess of the normal, there being an average of 400 lymphocytes to the field, and a proportion of three polymorphonuclear leucocytes to every lymphocyte. No organisms could be detected.

The patient's symptoms steadily increased and he became quite unconscious. The temperature suddenly rose to 104° F. shortly before his decease, six days after the first puncture. A second puncture was performed on the day of death. This showed pressure increased, but falling rapidly to normal. The Fluid/

Fluid was distinctly turbid with increase of albumin, and the cellular content showed a further increase of the proportion of the polymorpho-nuclear leucocytes, but again no organism was detected.

Post-mortem examination showed that there was an abscess in the right frontal lobe which had ruptured into the anterior horn of the right lateral ventricle.

No organism could be recovered on culture.

CASE VIII. In this case there was a history of chronic alcoholism. For three weeks there had been some failure of vision and for two days difficulty of speech. There was no history of headache or giddiness. The patient was in a very dazed condition and speech very thick; all the tendon reflexes were present and the plantar response was flexor; respirations/

respirations were slow and sighing. Two days later, patient had two fits of an epileptiform nature and there was an extensor response to the plantar reflex immediately afterwards. Patient never properly regained consciousness and the respirations became very noisy. A Lumbar Puncture was performed four days after admission, following the epileptiform seizure, and showed no changes from the normal. Patient died two days later, and at the post-mortem examination the cause of death was given as oedema and congestion of the brain.

CASE IX. This patient complained of weakness in the legs, and at times difficulty in walking. The gait was weak and of a rather ataxic character. There was no complaint of shooting pains and no calf analgesia. The tendon reflexes were sluggish. Muscular and joint reflexes were slow in giving response. Pupils were/

were normal. Patient admitted having had gonorrhoea, but denied having had syphilis. The possibility of tabes was considered. The Lumbar Puncture showed a normal fluid, a strong evidence against such a possibility.

G E N E R A L /

GENERAL SUMMARY.

As stated, a short summary is given at the end of each group of cases, the diverse nature of the groups making it difficult to take all the cases in one general summary.

In the first three groups where a diagnosis of syphilis might have been taken as fairly definite, there was general evidence of a pathological condition in the fluid with two exceptions viz. CASES VIII. and XII. in the tabes group. In CASE VIII., the pressure and albumin were normal and the cellular content averaged 10 lymphocytes. This lymphocyte count though above the normal was too low to give definite evidence, especially where the other symptoms were too indefinite to justify a certain diagnosis. In CASE XII. pressure and albuminous content were normal and the lymphocyte count only 6. In this case, however, there were not only most typical symptoms of tabes, but also a definite history of syphilis given. Thus no finding/

finding in the fluid could influence the diagnosis one way or the other. This case, therefore, stands out in marked contrast to the finding in the rest of the cases. Further, it shows that in tabes there are rare exceptions as in general paralysis. (Cases reported by Achard and Grenet, Joffroy and Mercier, Ballet and Delherm.)

The remainder of the cases gives a marked increase in the cellular content, most marked in the cases of cerebral syphilis, where the average runs high, being close on 300, and in these cases, too, the albumin showed increase. This increase of the albuminous content was more marked in cases of general paralysis than in those of tabes, which bears out the finding of L. Merzbacher, that the quantity of albumin in the fluid of general paralysis is much increased, whereas in that of tabes it is little if at all increased.

As regards CASE I. in the General Paralysis group, in which, on the third day after the first puncture, the patient's temperature rose, the fluid showing/

showing in the second puncture a large number of polymorpho-nuclear leucocytes, I can find no record of a parallel case in the literature at my disposal. Meningitis seems to be most unlikely, and not at all to meet the condition arising. On referring the case to one who has done much work on the cerebro-spinal fluid, I find that the other supposition is the correct one, viz. That during a congestive attack in General Paralysis, the pressure is increased and that polymorpho-nuclear leucocytes, frequently present in small numbers between attacks, are, during the attack, present in very considerable numbers.

In the group of cases diagnosed as cerebral syphilis, CASES III. and IV. where the symptoms of transient paralysis were the main factors in coming to a diagnosis, the cellular evidence was conclusive. CASE IV. was punctured while the paralysis was still marked, and whether this had anything to do with the large average count of 500, it was not easy to determine. But that the count did vary at different times/

times was shown by CASE I. in the tabes group, and CASE VI. in the last group given.

In the group of cases of intra-cranial tumour, no very definite conclusion could be drawn, the results varying to a great degree. Possibly the extent to which the tumour had grown when puncture was performed, would influence the findings. Unfortunately, in this group, punctures were not performed at intervals as the condition progressed, otherwise this doubt might have been settled. Some inferences, however, may be drawn from considering how early or late in the condition, judged from the symptoms present, the puncture was made. CASE I., which showed slight increase of albumin and an average lymphocyte count of 220, was punctured when the symptoms were well developed, and definite paralysis and optic neuritis had shown themselves. CASE II., which showed a lymphocyte count of 18, had developed hemiplegia some weeks previously, and had optic neuritis well marked.

CASE IV., showing increased albumin and giving a lymphocyte count of 25, was a case of long standing/

standing: a history of symptoms of over two years was given and the optic neuritis was also of long duration. The puncture was made shortly before the case terminated fatally, and meningitic symptoms had presented themselves.

CASE III., where the fluid showed no abnormal change except a slight increase of pressure, was done early in the condition and when the optic neuritis was in an early stage in one eye only. Post-mortem was held some five months later and there was definite involvement of the meninges by metastases from the primary growth.

CASES V. and VI. showing too, only slight changes in the fluid, were also punctured when the symptoms were in the early stages.

CASE VII. was punctured late on in the condition, when optic neuritis was well marked. Here, however, the condition was more in the nature of a large cyst, a small tumour the size of a bean being found near the foramen of Majendi.

From consideration of these points, it will be seen, that in cases where there was any considerable/

considerable tumour growth, definite change in the cellular element of the fluid had set in when the puncture was performed and after the symptoms had progressed for a considerable time. Where, however, the puncture was made when symptoms were in their early stages, the changes in the fluid were not in a marked degree, if at all varied from the normal.

CASE IV., however, in the last group of cases, where an intra-cranial tumour was found post-mortem, the puncture, although made a few days before death, showed no marked alteration in the fluid.

In this group of four cases of meningitis with the exception of CASE III., the diagnosis was only provisional and not made with any certainty, before the Lumbar Puncture gave conclusive evidence. CASE III. gave a very fair Clinical picture of the disease, and so also did CASE II. by the time the second Lumbar Puncture was made. When the first puncture in CASE II. was made, meningitis was only looked on as a possibility. The result of the puncture showed an increase of the lymphocytes, but no/

no increase of pressure, no turbidity of the fluid and no increase of the albuminous content. An examination of the optic discs was made and no change found, though later on in the condition, there was blurring of the edges of the discs. The interesting feature of the case was, that on the intervention of the pneumonic consolidation, the mild meningitic symptoms cleared up, and, as the lung quickly proceeded to the stage of resolution, pronounced and unmistakeable clinical symptoms of meningitis repidly advanced, these being borne out by the results of the examination of the cerebro-spinal Fluid.

CASE I. showed neither rigidity of the neck nor Kernig's sign, but the facial paralysis and the state of the reflexes taken with the history obtained, pointed to the probability of meningitis, and the diagnosis was clinched by the results of the puncture.

The peculiar feature was the difficulty experienced in reaching the fluid. As stated above repeated puncture had to be made, first between the fourth/

fourth and fifth vertebrae as usual, without success, and then only after repeated attempts between the third and fourth vertebrae, was the effort successful. There was never any doubt that the needle passed within the bony canal. The membrane must have been stretched and tense, because, when the fluid did eventually flow, it spurted out through the needle at high pressure. This probably pointed to the membranous sac being either shorter or narrower than is usually met with. CASE IV. was another instance in which there was some doubt as to the diagnosis before the puncture was made. The cellular and albuminous contents confirmed the probability.

In all four cases the points observed, with the exception of the cellular content, showed wide variation. The cellular content varied only in degree. In meningitis, the pressure is usually described as being considerably increased. Here in two Cases (I. and II.) it was very much increased, the fluid spurting out with considerable force: in the other two (III. and IV.) it came from the needle drop/

drop by drop without any increase of the normal pressure. In the two in which the fluid was under pressure, the fluid was definitely turbid.

In the other two Cases in which the flow was at a normal pressure, the fluid was quite clear. The albumin was markedly increased in I. and II., but only very moderately increased in the remaining ones.

In the last group of nine cases, in which the diagnosis was in doubt and the puncture was made to discover if its examination would throw light on the condition, the results, in most instances, were of a distinctly helpful nature.

CASE I. was one in which, from the early symptoms, a provisional diagnosis of a typical tabes had been arrived at. But a development of a further symptom proved contrary to this and led to a different conclusion. This was borne out by the cerebro-spinal fluid showing no change from the normal. If a puncture had been made when the early provisional diagnosis had been arrived at, the examination would have thrown grave doubts on its probability./

probability.

CASE II. was a case in which no further diagnosis was arrived at than an ascending affection of the anterior corneal cells. The fluid showed marked abnormality but threw no further light on the condition.

In CASE III. a doubtful diagnosis of general paralysis had been arrived at from the general symptoms. This was not in accordance with the findings in the fluid, and the subsequent history of the case bore out the truth of those findings.

CASE IV. Here no definite diagnosis was arrived at before the post-mortem examination was made, when an intra-cranial tumour was found.

The puncture was made a very few days before the fatal termination, but gave no help in diagnosis.

CASE V. showed very similar symptoms to the preceding one, but the termination was the reverse of it, as this patient steadily improved up to a certain point. The interest in the case was the/

the findings in the repeated examinations of the fluid. In the first, there was a good deal of blood, and on contrifuging the corpuscles, red and white, gave a good reaction to the stain. The second, made two days later, when the fluid was still blood stained, showed a large number of red and white corpuscles under the microscope, but the staining reaction was not so good. The third puncture, made a month later, showed a faintly yellowish stained fluid with an average of three to four mononuclear to the field, and a few much degenerated red blood corpuscles and polymorphonuclear cells. The coloration of the fluid on all three occasions remained after centrifuging.

At the time of the first puncture, the blood was thought to be due to one of the arachnoid veins having been punctured. Later, combining the results of all three punctures with the sudden onset, and the gradual though only partial clearing up of the condition, the tentative diagnosis of an intracranial haemorrhage was taken up.

CASE VI. was of great interest, as he was

under/

under observation on three occasions at intervals of roughly six months, and was punctured on each of the three occasions. When first the patient came under observation, he had most of the symptoms of general paralysis and on puncture the fluid showed increase of pressure, a large increase of albumin and an average lymphocyte count of 1,000, which bore out the diagnosis already arrived at. Six months later, the patient had improved very greatly, although his mental condition was still defective.

The puncture on this occasion showed neither increase of pressure, nor increase of albumin and the lymphocyte count had dropped to 20. Again, after another period of six months, the patient seemed in the same condition as on the former occasion, and his fluid showed a lymphocyte count of only 12, the albumin and pressure remaining normal.

The two latter examinations, as well as the patient's general improvement, upset the previous diagnosis of general paralysis, but the cause underlying the condition remained undetermined.

CASE/

CASE VII. Here the examination of the fluid was of undoubted value in arriving at a diagnosis. Before the puncture was made, there was a possible diagnosis of intra-cranial tumour, but the rapidity of onset of the symptoms was rather against this. The large increase of lymphocytes and especially the presence of polymorpho-nuclear leucocytes pointed to abscess formation. The second puncture showed turbidity of fluid, and the large increase in the polymorphs made this diagnosis, which was borne out by the findings at the post-mortem examination, more certain.

CASE VIII. Here the puncture was made to ascertain if evidence could be obtained of any syphilitic or bacterial cause of the condition, and was proved negative. On the possibility of cerebral oedema being the cause of the condition, a larger quantity of fluid than usual was drawn off, in order to relieve such condition, but no benefit was observed. The post-mortem evidence, however, showed the above as the cause of death.

The/

The general conclusions which can be arrived at as regards the use of Lumbar Puncture and the examination of the fluid, may be summed up in three heads:

(1) It is a simple innocuous procedure, sometimes in itself of therapeutic value.

(2) It is of great value in establishing diagnosis between functional and organic disease of the central nervous system.

(3) It enables the diagnosis of certain diseases to be arrived at in their earliest stages, and so permits of remedial measures under the most favourable conditions.

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